AECOM

Harnessing the Power of Water

Global Hydropower and Dams

AECOM has over 100 years experience in the development and design of hydropower and dam projects. We provide integrated planning, feasibility, design, environmental studies, permitting and licensing support, construction, project management and operations/ maintenance services to hydropower clients throughout the world.

Top:
Isabella Lake Dam
Kern County, California, U.S.A.

Front Cover:
Swift No. 2 Hydroelectric Rehabilitation
Washington, U.S.A.

Harnessing the Power of Water

Talented AECOM energy professionals around the world work closely with clients to meet their project needs. Our extensive experience in planning and design for sustainable power generation infrastructures helps us provide viable solutions for a clean energy future.

Our impressive hydropower and dams projects portfolio includes, to name just a few: the James Bay hydroelectric development with a total installed capacity of about 16,500 MW, located in Northern Quebec, Canada; La Sarcelle hydroelectric plant (150 MW), the first major hydropower bulb turbine project in North America, located in Northern Quebec, Canada; the feasibility study for Grand Inga, the biggest hydroelectric site in the world (with an estimated energy production potential of 39,000 MW) located on the Congo River in the Democratic Republic of Congo; Allain Duhangan hydroelectric development (192 MW), a strategic energy project in India; several hydroelectric power plants and dams rehabilitation projects in the United States; and many other major hydropower projects in Asia, Africa, Australia and New Zealand.

Our technical knowledge and experience is supported by the ongoing development of our program and project management and systems expertise, which incorporates the highest sustainability and safety principles.

Hydropower and Dams Services

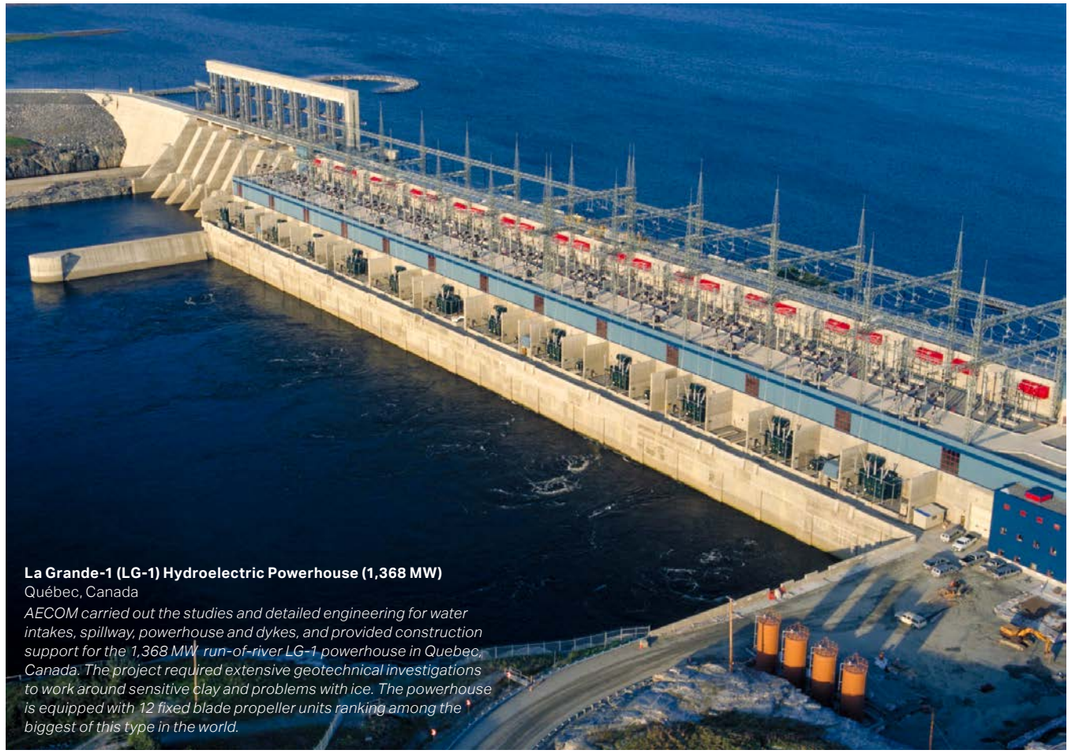
- Project identification and assessment of hydropower potential
- Probabilistic assessment of yield capabilities for hydropower generation
- Optimization of hydropower schemes
- Technical assistance
- Sustainable development
- Planning, including water allocation strategies
- Environmental services
- Physical hydraulic and CFD modeling
- Engineering design of new facilities and of all supporting infrastructure
- Rehabilitation and upgrading of hydroelectric power plants, dams and CM related facilities services
- Program management
- Commissioning services
- Construction
- Construction management
- Operation and maintenance guidelines
- Dam safety
- Licensing/Permitting
- Climate change adaptation
- Asset management

In addition to the traditional services for hydropower developments, AECOM acts as specialist advisor to private developers, government utilities, and lending/financing institutions for the planning and implementation of hydropower generation facilities.

We also have substantial experience and expertise in legal, regulatory, institutional, financial, technical, social and environmental frameworks and the formulation of model enabling environments.

As the sustainability agenda varies according to local factors and issues, we develop sustainable solutions at a local level to provide our clients with a unique blend of global reach, local knowledge, innovation and technical excellence.

Hydropower Engineering



La Grande-1 (LG-1) Hydroelectric Powerhouse (1,368 MW)
Québec, Canada
AECOM carried out the studies and detailed engineering for water intakes, spillway, powerhouse and dykes, and provided construction support for the 1,368 MW run-of-river LG-1 powerhouse in Quebec, Canada. The project required extensive geotechnical investigations to work around sensitive clay and problems with ice. The powerhouse is equipped with 12 fixed blade propeller units ranking among the biggest of this type in the world.

AECOM realized more than 140,000 MW of hydropower generation globally. With more than 100 years of experience in the development and design of hydropower projects, AECOM provides fully integrated project planning, feasibility, design, project management and operations/maintenance services to hydropower clients. We are world leaders in hydropower, dams and reservoirs, site relicensing, dam safety and flood control.

AECOM has an impressive track record in hydropower works throughout the world, ranging in size from less than 1 MW to above 5,000 MW. We have consistently delivered innovative technical solutions to our hydropower clients through a collaborative and open work style that enables us to understand client and project requirements.

AECOM's hydropower group provides complete "water to wire" services for:

- Dams, reservoirs, water conveyance & hydraulic structures
- Power plant design and refurbishment
- Power stations, switch yards, control and automation
- Transmission lines, substations and system analysis

Experience

- Hydropower project feasibility studies
- Specialist advice for private power development
- Due diligence and power studies
- Financial planning and corporate investment studies
- Environmental, social and anthropological studies
- Permitting and licensing
- Hydrological, topographical and geotechnical investigations
- System hydraulics, transients and model studies
- Design, supervision and project management
- Procurement assistance and bid documents preparation
- Construction
- Construction management
- Commissioning, operations and maintenance
- Asset valuations and management
- Power plant operation studies and efficiency improvements
- Safety reviews
- Refurbishments and upgrades
- Technology transfer and training

Hydropower Sample Projects

- Grand Inga feasibility study (39,000 MW), Democratic Republic of Congo
- La Grande-2 and La Grande-2A (7,616 MW), Canada
- Kafue Gorge feasibility study (600, 750 and 900 MW), Zambia
- Manapouri (700 MW), New Zealand
- Eastmain-1 (480 MW), Canada
- San Roque (345 MW), Philippines
- Buon Kuop (280 MW), Vietnam
- Bogong (140 MW), Australia
- Sidney A. Murray (192 MW), U.S.A.
- Sambangalou (128 MW), Senegal
- Xacbal (94 MW), Guatemala
- Owen Falls plant extensions (2 X 40 MW), Uganda
- Steelpoort pumped storage scheme site selection and feasibility study (1,000 MW), South Africa

From top:
Alain Duhangan Hydroelectric Project (192 MW),
Hymachal Pradesh, India

Mrica Hydropower Project
Indonesia

Dams and Reservoirs

Olmsted Lock and Dam
Illinois, Pennsylvania, U.S.A.
AECOM is lead partner to construct this 2700-ft-long concrete dam across the Lower Ohio River. The dam includes five 110-ft tainter gates and a navigable pass section with boat-operated wicket gates. In-the-wet construction includes use of a 5100-ton-capacity super gantry crane (pictured) to move precast concrete elements of the dam.

A full range of engineering services for any type of dam.

AECOM's dam and reservoir design professionals combine their extensive experience with advanced technical expertise, supported by specialist software, to evaluate the optimum type and dimensions of each structure to suit every particular location. We can provide specialists in all types of dam design, including homogeneous and zoned earth fill, rock fill, CFRD, ACRD, RCC, mass concrete, concrete buttress, concrete arch and other designs.

Our broad capability across the engineering of dams and reservoirs includes:

- Planning and design for dams, reservoirs, intakes, waterways and associated hydraulic structures
- Flood analyses, hydraulic and structural design and model studies of spillways
- Geotechnical, geological, hydrogeology, hydrological and geo-mechanical investigations
- Slope stability assessments and engineering
- Dam break analysis, safety and seismic assessments and engineering
- Dam safety inspections, including FERC Part 12
- Rehabilitation and refurbishment
- Cost estimates (capital, operation and maintenance, as well as rehabilitation)
- Site monitoring and supervision
- Water resources planning and management

AECOM designed, planned and built more than 175 dams and reservoirs on all continents.

Dam Sample Projects

- Boruca Dam (260 m), Costa Rica
- La Grande-2 main Dam (167 m), Canada
- Mohale Dam (145 m), Lesotho
- Nam Tha-1 (133 m), Laos
- Manic-3 Dam (131 m), Canada
- La Romaine-2 Dam (114 m), Canada (under construction)
- Kef Eddir Dam (93 m), Algeria
- Bienh Dien Dam (80 m), Vietnam
- Wolf Creek Dam (79 m), U.S.A.
- Toulnustouc Dam (77 m), Canada
- Bivane Dam (72 m), South Africa
- Boussiaba Dam (52 m), Algeria
- Spring Grove Dam (37 m), South Africa
- Prado Dam (20 m), U.S.A.
- Megget Dam, Scotland, UK
- Technical assistance for Cohorra Bassa Dam, Mozambique
- Braamhoek pumped storage scheme—dam design preview, South Africa
- Diamond Valley Lake, U.S.A.
- Olmsted Lock and Dam, U.S.A.

From top:
Diamond Valley Lake
Winchester, California, U.S.A.

Rangipo Dam
Waikato, New Zealand

Structures

Swift No. 2 Hydroelectric Rehabilitation
Washington, U.S.A.

AECOM provides comprehensive services for planning, design and construction as well as rehabilitation of power plants and associated equipment, including mechanical, civil, structural and electrical.

Plant and Associated Equipment

Our professionals realize the design/selection/specifications of the main mechanical and electrical generating plant equipment items using specialist software to determine:

- Turbine type (Kaplan, Francis, Pelton, Bulb, kinetic), number and rated turbine output, head, speed and setting height, maximum allowable speed increase and pressure fluctuations in the upstream waterways, and powerhouse layout and key dimensions.
- Main characteristics of the generator, such as rated output, overload capacity, power factor, voltage and other performance requirements, layout of generator transformer and switch gear, control and protection equipment.

Rehabilitation of Hydroelectric Developments

In addition to a wide strong expertise in new power plants, AECOM acquired experience in rehabilitation and modernization of existing hydroelectric developments and associated equipment, in order to increase performance and safety and decrease maintenance costs.

This experience applies to small, medium and large plants and structures ranging from 10 to 90 years old, for all generating unit types and for the hydraulic structures (concrete gravity and arch dams, RCC, spillways, weirs, sluiceways, intake structures rock fill and earth fill dams, heavy mechanical equipment, etc.)

From left:
Prado Dam, Gates and Control Tower Replacement
Corona, California, U.S.A.
AECOM provided services to the US Army Corps of Engineers to raise the dam by 65 feet, and to replace the gates and control tower at the Prado Dam.
The improved storage and release capacities of the dam that were achieved through this project enable the dam to take full advantage of the improved channel capacity downstream. They also greatly increased the level of flood protection to the communities of Orange County in the Santa Ana River floodplain.

Independent Review of Sauzal Hydropower Station (76.8 MW),
Chile

Rehabilitation Sample Projects

- Spillway rehabilitation for La Tuque power plant (281 MW) affected by alkali aggregate reaction, Canada
- Rehabilitation of Warsak hydroelectric power plant (240 MW), Pakistan
- Rehabilitation of Macchu Pichu hydroelectric power plant (107 MW), Peru
- Chute-à-Bésy dam reconstruction, Canada
- Assessment, rehabilitation and modernization of Cambambe and Biópio hydropower plants, Angola
- Rehabilitation of segment gates of Cadarache Dam, France
- Rehabilitation of Peligre power plant (54 MW), Haiti
- Paugan powerhouse equipment automation and modernization, Canada
- Rehabilitation of T/G units of EDÉA I, II and III power stations, Cameroon
- Turbine capacity improvement for Wailsa hydropower station (83.2 MW), Fiji
- Bakun hydropower station (70 MW) emergency rehabilitation, Philippines
- Upper Mangata Whiri dam upgrade (40-m high), New Zealand
- Abiquiu hydroelectric project extension (16.9 MW), U.S.A.
- Rehabilitation of the Rivière-des-Prairies power house superstructure, Canada
- Genesis Energy hydropower stations control system upgrade, New Zealand
- Afulilo hydropower station upgrade, Samoa
- Swift No. 2 Hydroelectric rehabilitation (80 MW), U.S.A.
- Rainbow Hydroelectric redevelopment (62 MW), U.S.A.
- Thomson Forebay remediation, U.S.A.
- Nine Mile powerhouse upgrade, U.S.A.

Tunnels and Underground Infrastructures

From left:
La Grande-2 Underground Hydroelectric Powerhouse (5,616 MW)
Québec, Canada

Rockwater Power Project (260 MW)
Waitaki Valley, New Zealand

We provide cost-effective innovative engineering design for underground structures related to hydropower generation. Our experience in planning, design and construction of underground infrastructures includes numerous underground power plants, often located in difficult terrain and problematic ground conditions.

With the successful completion of over 650 km of tunnel projects around the world, AECOM has the knowledge to provide technical and innovative solutions for all types of tunnel and underground infrastructure projects, no matter how complicated or challenging they may be.

Our expertise in tunnelling and underground infrastructure includes:

- Site investigation and geology
- Geotechnical and hydro-geology modelling and interpretation
- Hydraulic modelling and design
- Tunnel and cavern design
- Electrical systems, lighting and ventilation
- Fire and life safety
- Water and wastewater

AECOM's professionals cover all disciplines in mechanical, electrical, rock mechanics, geology, geotechnical, metals engineering, civil and project management, with in-depth knowledge of the excavation techniques at international level.

La Grande-2 (LG-2) and La Grande-2A (LG-2A) Underground Hydroelectric Developments, Canada

LG-2 and LG-2A hydroelectric developments, owned by Quebec's utility Hydro-Quebec, are considered the world's biggest underground hydropower schemes, with a total combined installed capacity of 7,616 MW.

LG-2 generating station is one of the most impressive underground hydropower developments in Canada. It has an installed capacity of 5,616 MW, and is considered North America's most powerful underground hydroelectric powerhouse. LG-2 includes 16 turbine-generator units of 351 MW each, a water intake, sixteen 8-m diameter and 525-m long concrete-lined penstocks, a 28-m wide and 50-m high machine hall, 16 bus shafts, twin surge chambers and four tailrace tunnels, an access tunnel, an elevator shaft, two ventilation shafts and a 735 kV switch yard.

LG-2A is an underground hydroelectric power station with an installed capacity of 2,000 MW. It is adjacent to LG-2, and the intake structure is located on the same reservoir as LG-2 power plant.

AECOM received the Schreyer Award, Canada's highest distinction in the engineering field, for the excellence of its work on the LG-2 hydroelectric development.

San Roque Multipurpose Dam (345 MW)
Luzon, Philippines
AECOM provided engineering, procurement, and construction for this massive project under a complete turnkey, lump sum, fixed price design-build contract. Project features include a 650-ft-high embankment dam, below grade powerhouse, and more than 4 miles of tunnels and subsurface galleries.

Program and Project Management

Malana Hydroelectric Development (86 MW)
Kullu District, Himachal Pradesh, India

At AECOM, we know that the best foundation for successfully managing programs and projects is an in-depth understanding of our client's individual requirements. This understanding, combined with risk management, timely communication and robust project controls and reporting, has earned AECOM a reputation for management excellence around the world.

Our flexible approach has been applied to a wide range of industries, project types and project phases across planning, design, procurement, construction and operations.

We tailor our services to meet our client's requirements. AECOM's delivery methods include:

- Engineering, Procurement and Construction Management (EPCM)
- Program Management and Construction Management (PMCM)
- Alliancing

We also participate as key members of the following contract delivery methods:

- Early contractor involvement
- Design-build-construct
- Design-bid-build

Our managers, environmentalists, engineers, procurement and contract professionals work together to deliver excellence in programs and projects.

Nam Theun 2 Hydroelectric Power Project (1,070 MW),
Lao People's Democratic Republic (PDR)

AECOM was the Owner's Engineer for both Phase I and Phase II of the 1,070 MW Nam Theun 2 Project in Central Lao PDR. Our work for Phase I involved assistance with the final design, drafting of the EPC contract documents, project liaison and contract mediation. Phase II involved design review, specialist advice, site coordination, witnessing of commissioning support, manufacturing inspections and testing. Nam Theun 2 is a Build-Own-Operate (BOT) project, exploiting a 350-m head, and produces close to 6,000 GWh per year, most of which will be exported to Thailand.

Environmental Assessments

Conawapa Hydroelectric Project,
Manitoba, Canada
Oceanographic studies of Nelson River Estuary for Environmental Impact Assessment.

We provide an integrated approach to help our clients combat climate change and incorporate sustainability to their projects.

Our whole-of-life approach to environmental management extends beyond the pre-planning stage to include feasibility studies, design, implementation, commissioning, subsequent monitoring and environmental site management.

AECOM works closely with regulatory agencies to ensure the adequacy of baseline studies for compliance with government permit requirements.

We help our clients differentiate themselves through the adoption of strategies designed to help fight climate change and incorporate sustainability thinking into their planning and operations.

Our worldwide team can deliver a complete range of services and integrated suite of environmental solutions, including:

- Environmental impact assessments and auditing
- Sustainable water management
- Energy management
- Environmental management
- Cleaner production/eco-efficiency assessments
- Life-cycle analysis
- Business continuity plans
- Social and environmental protocols and performance indicators
- Permitting and licensing approvals
- Due diligence evaluations and strategic advice
- Climate change response services
- Community engagement and research programs
- Corporate sustainability reporting

AECOM understands the value of our natural environment and the need to minimize impacts from society and industry. Our talented environmental professionals have a long history of providing solutions for private and public clients around the world.

Boundary Hydroelectric Relicensing Project
Washington, U.S.A.
Boundary Dam, located on the Pend Orielle River in Washington is Seattle City Light's (SCL) major hydroelectric power generating resource. The scheme includes a 104-meter high variable radius concrete arch dam, with two service spillways, seven low-level sluices through the dam, and a power house with six turbines, with a total installed generating capacity of 1,070 MW.

About AECOM

AECOM is the world's trusted infrastructure consulting firm, delivering professional services throughout the project lifecycle – from advisory, planning, design and engineering to program and construction management. On projects spanning transportation, buildings, water, new energy and the environment, our public- and private-sector clients trust us to solve their most complex challenges. Our teams are driven by a common purpose to deliver a better world through our unrivaled technical and digital expertise, a culture of equity, diversity and inclusion, and a commitment to environmental, social and governance priorities. AECOM is a *Fortune 500* firm and its Professional Services business had revenue of $13.1 billion in fiscal year 2022. See how we are delivering sustainable legacies for generations to come at aecom.com and @AECOM.

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